Energy Saving Technologies for

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Overview

- Characterize Industrial Facility Energy Use
  - Electricity
  - Fossil fuels
    - Steam generation
    - Process & building heat
- Identify energy saving methods and techniques for Industrial Facilities

Industrial Electrical Energy Use

Automotive MFG – (1985, 2000 & 2001)

- Painting Systems = 27 - 50 %
- Ventilation = 11 - 20 %
- Lighting = 15 - 16 %
- Compressed Air = 9 – 14 %
- Welding = 9 – 11 %
- Metal Machining & Forming= 2 - 9 %
- Material Handling = 7 – 8 %
- Other = 4 - 5 %

Industrial Total Energy Use

Automotive Manufacturer (Mid 1970's)

- Ventilation = 32 %
- Metal Casting = 17 %
- Liquid Heating = 13 %
- Painting & Ovens = 11 %
- Furnaces = 9 %
- Metal Machining & Forming= 5 %
- Lighting = 3 %
- Assembly & Welding = 3 %
- Other = 7 %

Technology Areas for Energy Savings

- Process Improvements
- Utility & Facility System Reductions
  - Ventilation Systems
  - Heating Systems
  - Cooling Systems
  - Compressed Air
  - Electrical

Process Improvements

- Plan production tasks to operate processes when needed
- Match production equipment to suit requirements
- Reduce excess capability
- Consolidate operations between facilities
- Change product/substitute materials

Ventilation System Functions

- Remove airborne contaminants
- Dilute airborne contaminants
- Pressurize the building
- Provide temperature control
- Maintain space cleanliness

Ventilation Energy Use

- Fan Motor Use
  - Air volume **HP = Q x SP/(6362 x Eff)**
  - Pressure drop
- Air Tempering
  - Conditioning outside air
    - Make-up air **BTUH = 1.08Q(T diff)**
    - Infiltration
  - Building shell losses **BTUH = UA(T diff)**

Ventilation Systems

- Air Flow Quantity for Contaminant Control
  - Dilution = most air flow
  - Hoods
  - Close capture hoods
  - Enclosures
    - Booths
    - Tank lids

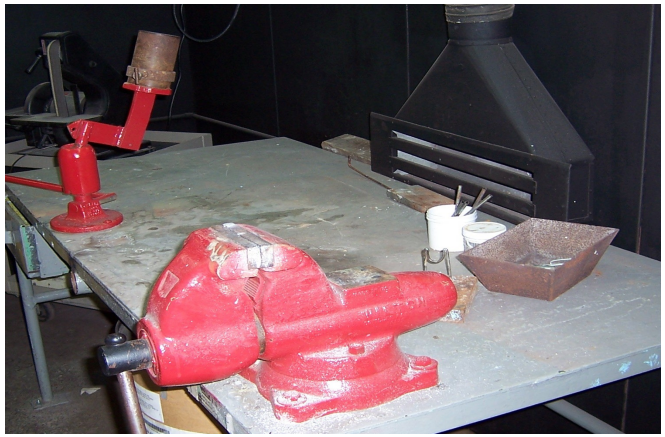
Ventilation Energy Savings

- Reduce air flow - Use efficient contaminant capture
  - Dilution = most air flow
  - Hoods
  - Close capture hoods
  - Enclosures
    - Booths
    - Tank lids
- Material substitution
- Select better controls

Dilution Ventilation

- Need to mix airborne contaminant with clean air until concentration is a safe level.
- Extra air required to assure proper mix.
- Uses more air than other contaminant control methods. For example – 5,000 CFM required to dilute exhaust from one automobile compared to 200 CFM to remove exhaust with close capture tail pipe hose.

Hood Exhaust



- Exhaust air flow increases by the square of the distance to the source.
- Avoid drafts

$$Q = V (5X^{2} + A)$$

Close Capture Hood Exhaust

- Hood designed for application to capture & contain contaminant
- Can be single or multiple drops
- With proper air cleaning device can recirculate exhaust air.

Enclosures and Booths

- Airborne contaminant contained
- Apply exhaust for removal
- Air exhaust depends on velocity through openings
- Best protection

Material Substitution

Elimination of

- Lead based paints
- Asbestos brake linings
- Chrome trim on vehicles

Select Better Controls

- Enable ventilation system respond to
  - Time of use
  - Process operation change
  - Climate

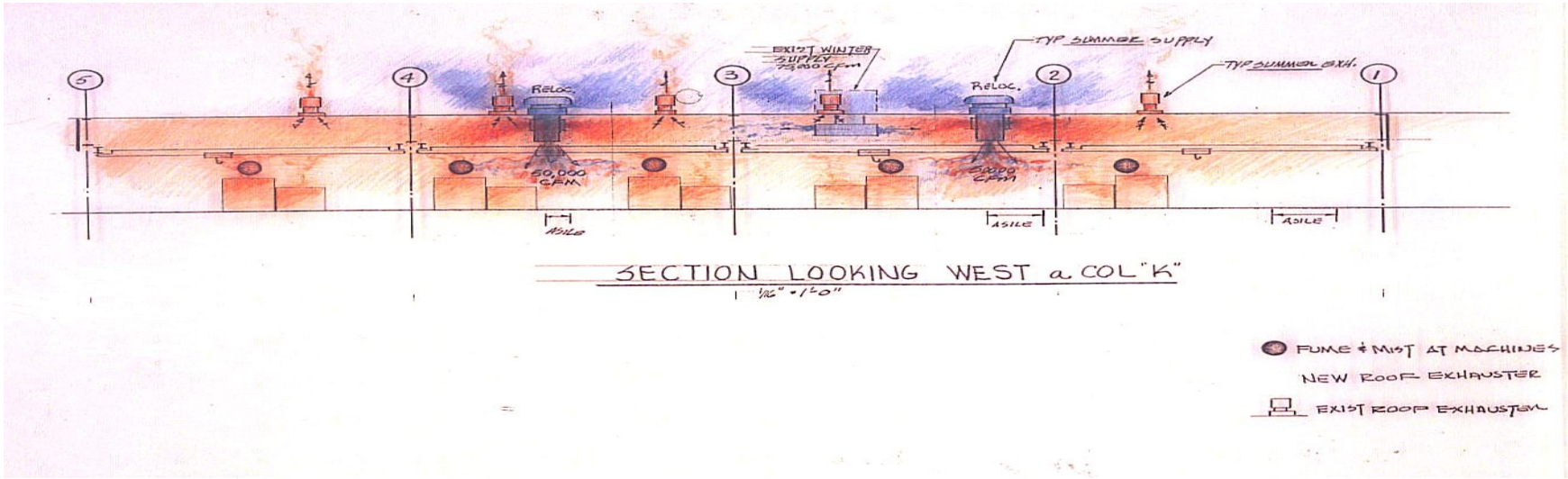
Ventilation Energy Savings Cont.

- Minimize air pressure drop
  - Reduce duct bends
  - Mimimize use of flexible ducts
  - Match air velocity to contaminant
  - Select appropriate air cleaning devices
- Minimize air tempering
  - Reuse process heat/heat recovery
  - Use temperature stratification
  - Reduce Infiltration
  - Improve building “U” factor

Types of Supply Ventilation Systems

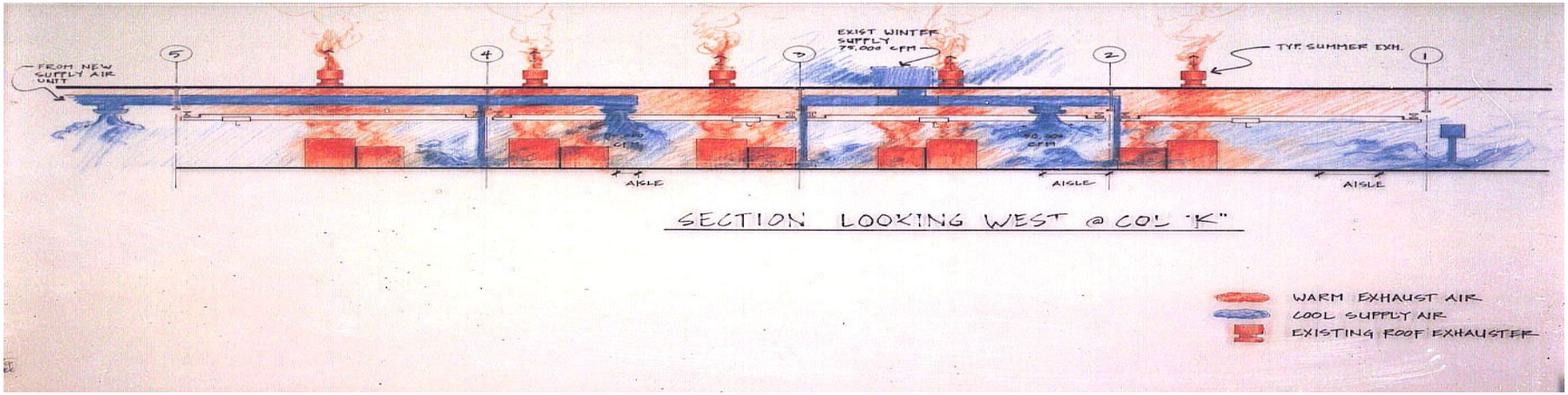
- Mixing
- Displacement
- Spot cooling
- Building pressurization
- Natural Ventilation

Air Mixing



- Uniform temperature
- Uses high velocity jets
- Good for dilution ventilation, bad for hood exhaust

Displacement Ventilation



- Warm air with airborne contaminants will rise
- Low air velocity in space with workers
- Cooler space temperatures

Spot Cooling

- Conditioned air delivered to specific work stations
- No attempt to condition total building area
- Air outlets close to workers to minimize entrainment of building air
- Air velocity adds to the cooling affect

Building Pressurization

- Exhaust systems demand outdoor air either through supply systems or infiltration
- Supply air quantity greater than exhaust amount
- Reduces drafts and improves cleanliness
- Effective for winter air distribution

Central Heating Systems

- Alternate systems to reduce steam use
  - Cold water washers
  - Electric motors
- Use local steam generation
- Isolate to areas having no demand
- Use other energy sources for building heat
  - Natural gas
  - Heat recovery

Cooling Systems

- Evaporative Cooling
- Direct Expansion Refrigeration
- Thermal Storage Systems
  - Chilled Water
  - Ice

Utility & Facility Reductions Cont.

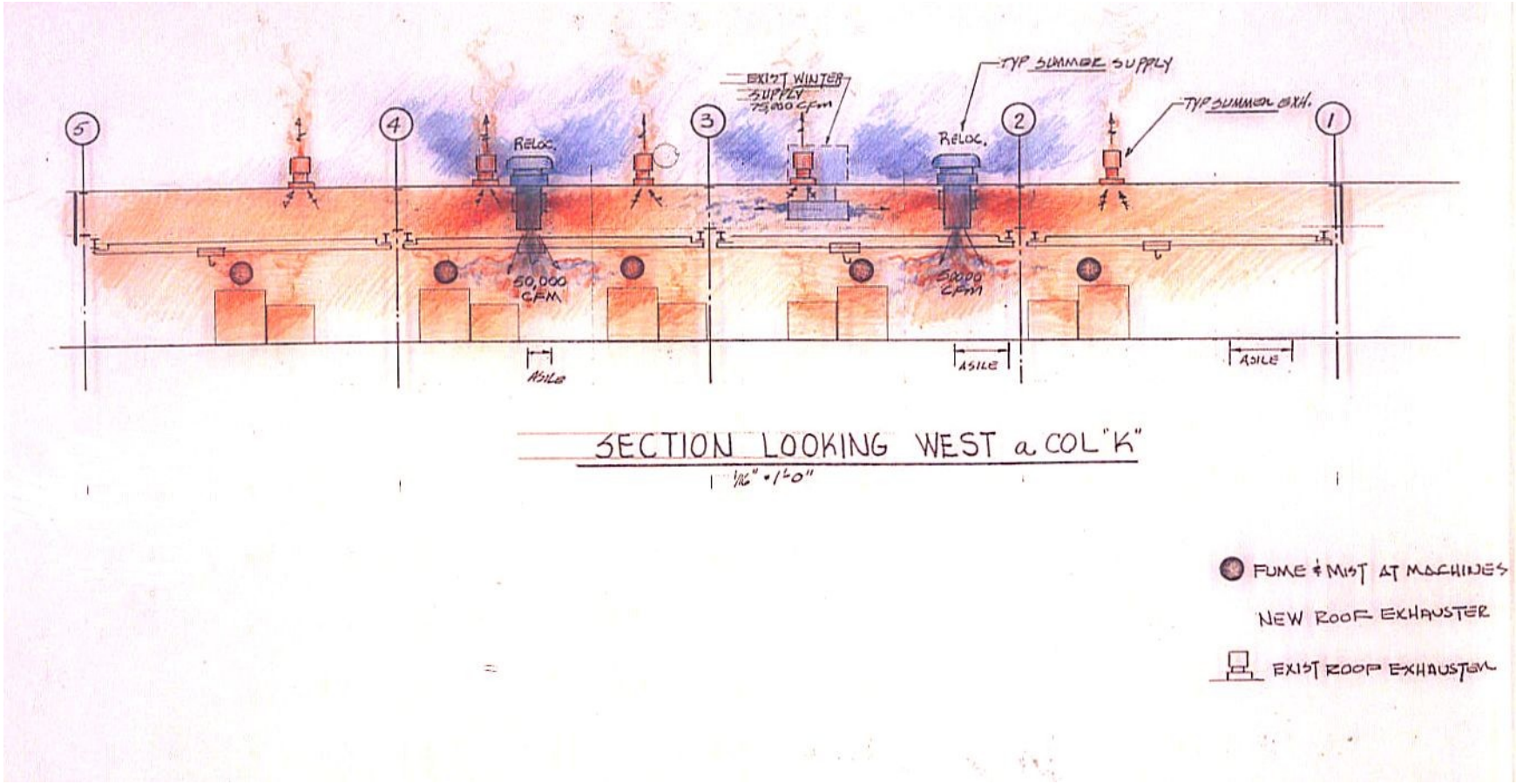
- Electrical
  - Match equipment to loads
  - Utilize more efficient equipment
- Compressed Air
  - Replace older equipment
  - Heat buildings with warm air off air cooled units

Summary

- Many DOD Industrial Facilities are job shops having little long term program activity.
- Good planning of production activities will result in more efficient use of equipment.
- Know you production bottlenecks and limitations and work to reduce their impact on product through-put and energy use.

Questions?

Mixing Ventilation



Displacement Ventilation